LUBRICATION

A Technical Publication Devoted to the Selection and Use of Lubricants

Published by
The Texas Company, 135 East 42nd Street, New York City
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Vol. XXIII March, 1937 No. 3

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Spindle Design and the Function of Spindle Oils

THE textile spindle as the basic element in spinning yarns was first considered as such in the development of mechanical or ring spinning which took place during the middle of the eighteenth century. It was a factor in the patents of Paul, Hargreaves and Arkwright in their studies which have led to the modern ring spinning frame; likewise it was employed by Crompton in his designs covering the mule spinning frame about the time of the American Revolution.

All these inventors, however, were simply applying the principles of mechanics to an idea which dates back to antiquity. The primitive spindle, as designed to impart rotary motion to the yarn on the spinning wheel, was first made of wood, tapering towards both ends and whirled by hand. Later this crude method of rotation was improved upon by mounting the spindle horizontally in bearings and whirling it by a band or tape connection to a large wheel which in turn was operated by foot-power through a simple eccentric connection.

Today, however, the modern spindle is mounted vertically, in a bearing which is virtually the heart of the spinning frame. The ancients may have discovered the value of spindle bearings, but twentieth century civilization brought them to perfection and keyed their design to mass production machinery.

And yet, until but a generation ago, the textile industry was still in the dark ages, for proper spindle operation at thousands of revolutions per minute could only be attained by effective lubrication of the spindle bearings. When fixed oils of animal or vegetable nature were the only lubricants available, spindles were lubricated with more or less difficulty, for animal or vegetable oils can never be dependable for long-time lubrication due to the ease with which they oxidize, and the gummy residues which may be developed.

The advent of the petroleum industry, the latter part of the nineteenth century saw a decided change for the better in textile mill operations. The science of distillation had been proved capable of producing straight mineral lubricating oils of a wide range of viscosity. Almost immediately the cotton industry seized upon those lower viscosity cuts which are so applicable to high speed operations with minimum power consumption.

In those days power economies were deemed of importance along with positive operation. Then the function of a spindle oil was considered to be solely lubrication in the attainment of the above. Today, however, the theory of spindle design has assigned two definite functions to a spindle oil, viz.:

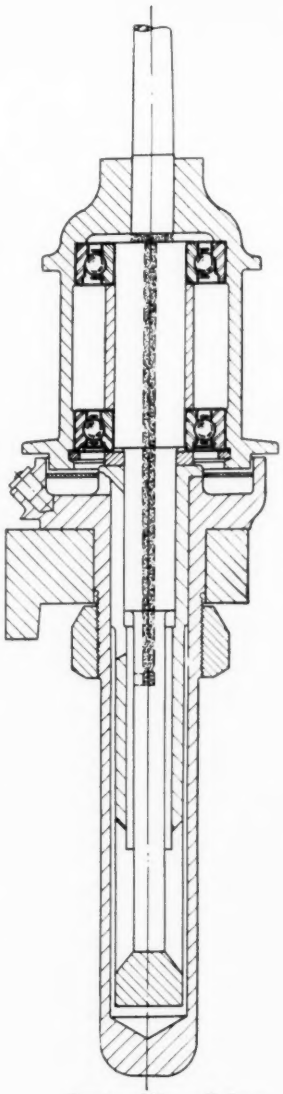
(1) To serve as a shock-absorbing element or buffer to prevent vibration or hunting, and
(2) To serve as a lubricant in the reduction of friction, the prevention of wear and attainment of power economy.

VIBRATION AFFECTED BY SPEED

Spindle speeds in the modern spinning frame have been materially increased in recent years.

From an early high of some three thousand R.P.M. an average of ten thousand now prevails in cotton mill operations, twelve to fifteen thousand in the silk industry and upward of twenty thousand in rayon spinning.

Speeds of this nature develop conditions of vibration which may cause faulty spinning with an excess of end breakage, unless this vibration is prevented. It is impracticable to design the spindle base and bolster as to entirely accomplish this result, hence the primary function of the spindle oil as a shock-absorbing assistant. In fact, in the opinion of some authorities lubrication can almost be regarded as of secondary consideration, even though it is most essential as an aid to elimination of wear.



Courtesy of Norma-Hoffmann Bearings Corp.

Fig. 1—Details of a twister spindle with open separable type ball bearing at upper end and shielded closed type at lower end. Oil wick lubrication is employed.

RELATION OF SURFACE FINISH TO LUBRICATION

For lubrication to be most effective the contact surfaces of the spindles and bolsters must be as perfect as possible. Spindles being of high grade steel can be accurately machined. Bolsters, however, are of cast iron, hence they must be run in to bring about a suitable glaze which will be conducive not only to continued lubrication but reduced wear. Unless this surface glaze is properly developed shortly after the spindle assembly is put in operation, vibration cannot be effectively prevented.

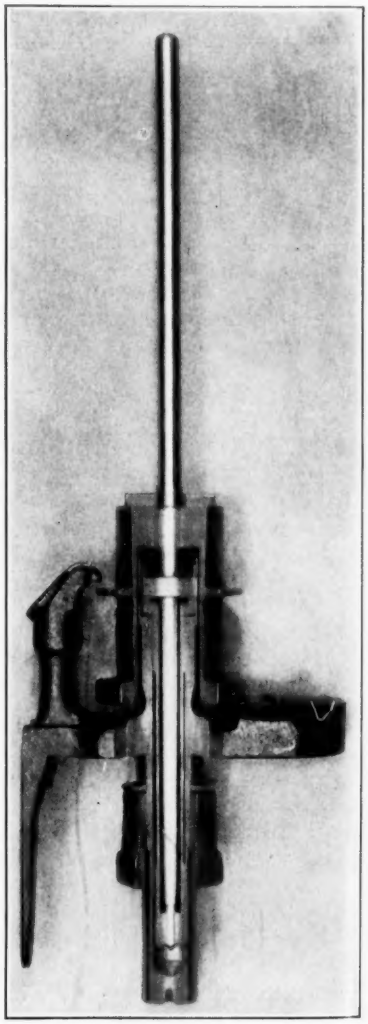
In order for a lubricating oil to function at its best it must be highly resistant to break-down or oxidation. Should this occur in service, sludge may be developed to interfere with the cushioning or dampening ability of the remaining oil.

THE OPERATING CONDITIONS

Spinning and twisting in textile mill operations are those procedures whereby the fibres of the raw stock, after being suitably cleaned and straightened, are twisted into the form of yarn. Spinning as the primary operation takes the roving and, by imparting twist, develops strength, uniformity and coherence.

Courtesy of SKF Industries, Inc.

Fig. 2—Cross-section of an SKF roller bearing spindle adapted to Whitin frame design.



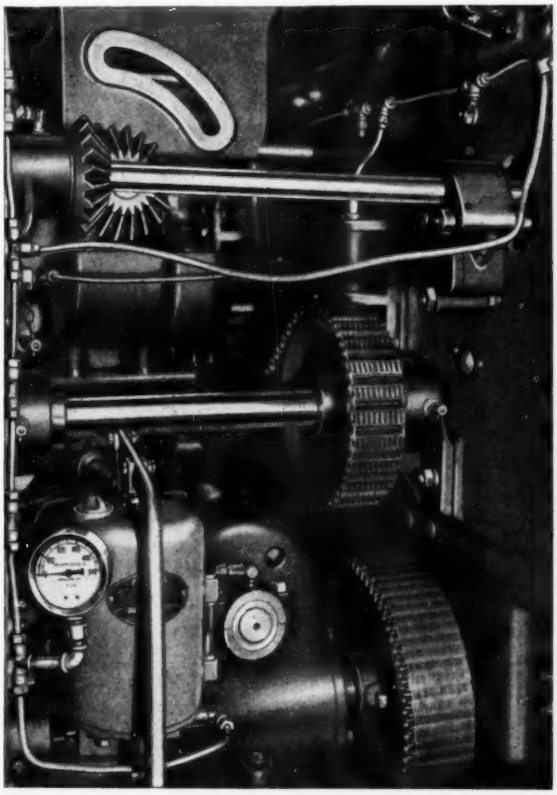
Courtesy of Saco-Lowell Shops

Fig. 3—Showing a Saco-Lowell high speed ball bearing twister spindle designed to reduce vibration. This design requires less frequent oiling than the conventional type and is claimed to operate with less power consumption.

Twisting is more of an incidental operation.

In many cotton mills, where there may be several hundred spinning frames and perhaps only a few twisting frames, the latter are used simply to produce novelty yarn or perhaps rayon and cotton. In the worsted mill, the twister frames which are of the ring type in the Bradford system, twist the yarns taken from either the cap frames in the Bradford system or mules in the French system.

A variety of mechanisms are necessary to make up the modern twisting or spinning frame. All must be thoroughly coordinated with respect to one another, and are therefore requiring of positive lubrication. They involve a variety of speeds, but fortunately the load and temperature ranges are rarely severe. Speed requires most careful consideration in connection with the spindles. The transition which has occurred in this regard has already been mentioned. It has led especially to intensive study of design, from the viewpoint of increased oil capacity in order to reduce the frequency of oiling and the development of oxidation and sludge, and to insure greater protection against dust and dirt contamination. More attention to lubrication and reduction in power consumption has also been necessary due to the trend towards increase in spindle speeds.



Courtesy of Whitin Machine Works

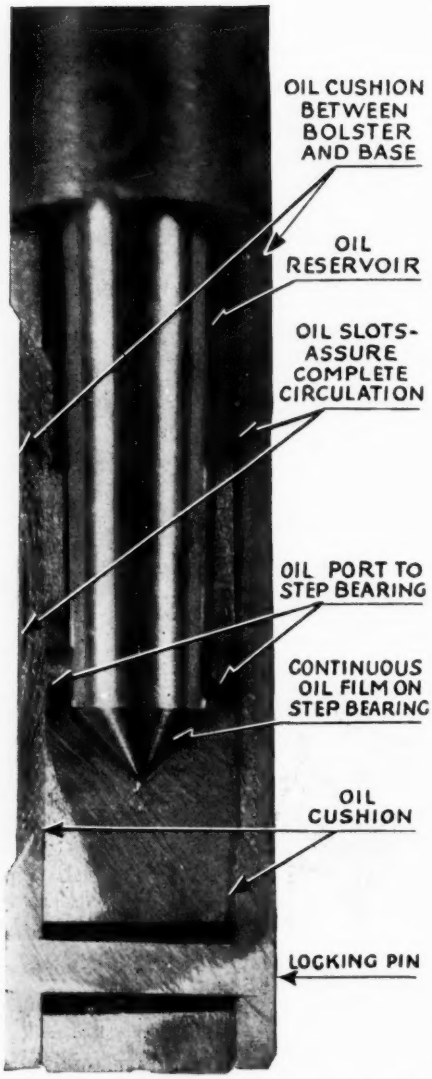
Fig. 4—Head end right hand section of a Whitin Model "E" wool spinning frame, showing lubrication supply and control for one-shot oiling system. All bearings in the head, except the ball bearings, are lubricated from the reservoir at a single draw of the plunger.

Viscosity and Temperature Difference.

The selection of a spindle oil today must therefore be approached in a most careful manner, for if the oil in service is unable to function with a minimum of drag, power or friction losses, excessive tension may be imposed on the yarn. Frequent end breakage and high power consumption will be indicative of such a condition. Temperature difference has come to be regarded as of vital importance in this connection, and the difference which may exist between the room temperature and the temperature of spindles is now accepted as a primary indication of the lubricating and friction-reducing ability of a spindle oil. The ideal would obviously be an absence of any difference in temperature.

Friction can never be entirely eliminated, however; so spindle oils will almost always be subjected to an operating temperature somewhat above that of the surrounding atmosphere. With a high grade spindle oil this temperature difference may range from 7 to 15 degrees.

We are not alone concerned with contact or metallic friction, however, for there will also be the internal or molecular friction within the oil to be considered. Consequently the oil viscosity becomes an important item in this regard, for the higher the viscosity of the oil, the greater will be the internal friction, or resistance to shear, between the molecules, with the result that more power will be required to drive the spindles. For this reason every care should be taken to observe and record spindle operating temperatures, and reduce the viscosity of the oil as far as possible. Reduction in viscosity of a spindle oil should never be carried to an extreme, however, due to impairment of oil film strength and the possibility of subsequent metal-to-metal contact; this would lead to an increase in metallic friction which would cause excessive wear. The forerunner of all this would be marked increase in spindle temperatures, excessive power consumption, and those other conditions which have been mentioned above.



Courtesy of Saco-Lowell Shops

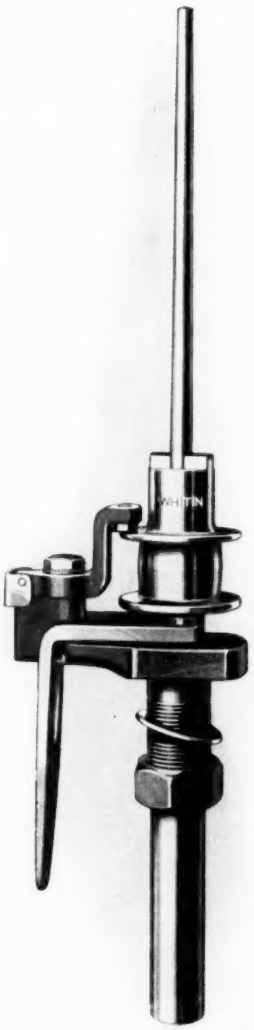
Fig. 5—Enlarged section through loose locked step of a Saco-Lowell McMullan spindle. Features of this design include large oil capacity and uniform and continuous circulation of oil.

Cleanliness: A Function of Refining and Care

Resistance to oxidation, breakdown and sludge formation has already been mentioned. It involves chemical stability; the better this is, the more dependable will be the spindle oil. This is the responsibility of the petroleum chemist. The mill manager can be assured of this if he will select spindle oils of high refinement and subsequently protect them in storage and service. In turn the mill operator must assume the responsibility of keeping these oils clean. They can be kept free from external contamination by storage in clean tanks, free from dust and dirt, and handling only in clean containers when re-lubricating. Contact with yarn is always objectionable, but doubly so if the oil is dirty or of poor quality.

Frequently, however, constructional details or adverse operating conditions will render this a difficult ideal to attain. For this reason, it is always advisable to use a mineral oil as light in color as is available, since color is a visual indication of the degree of refinement.

Maintenance of a cleanly condition can be subsequently assured by flushing spindle reservoirs at regular intervals and refilling with fresh oil. This is something many operators regard as unwarranted and but a troublesome expense. On the other hand, they must realize that a certain amount of foreign matter will always gain entry, ultimately to cause wear, increased friction, discoloration of the oil, and perhaps very serious staining of the yarn. Study of many tests, furthermore, has proved that routine cleaning is beneficial in reducing power consumption, it having been observed that the latter will usually vary directly with the degree of cleanliness of the spindle base.



Courtesy of Whitin Machine Works

Fig. 6—Exterior view of a Whitin twister spindle.

Handling of spindle oils in service requires intimate knowledge of design and construction; the more so when we consider that the spinning department of the average cotton mill, for example, will take approximately 60 per cent of the entire amount of power consumed by the mill. Design will vary, of course; the mule spinning frame being drastically different from a ring spinning unit. Both accomplish the same purpose, however, according to the nature of the yarn to be handled; both require the utmost freedom of motion in their spindles, with complete protection of the yarn against oil spots. The petroleum chemist, by specialized refining, can assure that the latter will be least objectionable; the mill

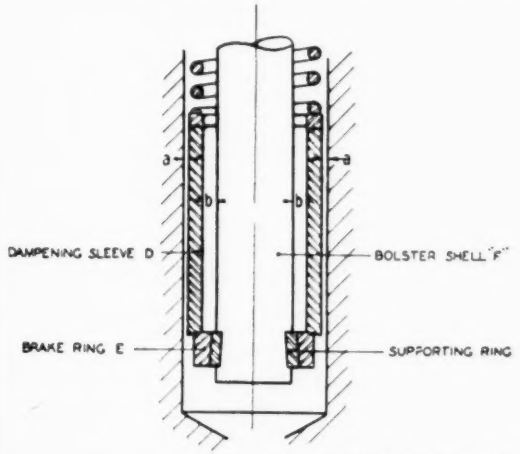
designer in conjunction with the operator, must make the provisions against their occurrence.

The cotton mill spinning frame, along with its spindle lubrication requirements, has been briefly touched upon above. Furthermore, as the basis upon which all spindle developments have originated, it is probably so well-known as to render further discussion superfluous. Silk, worsted and woolen operation, however, are not so familiar.

SILK AND RAYON REQUIREMENTS

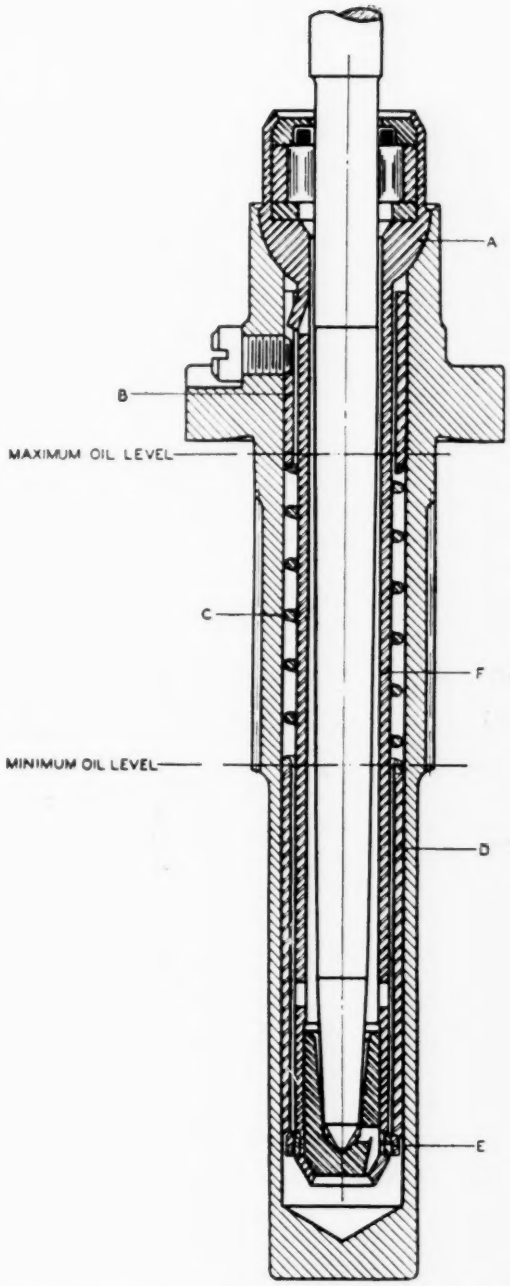
The process of spinning in the silk mill is termed "throwing." Lubrication of the machinery essential to this work requires careful study of spindle oils and spindle construction to reduce the tendency towards loss of oil by centrifugal force, and damage to yarn. Speeds are extremely high in silk throwing; in fact, in the handling of rayon, otherwise known as artificial silk, the highest spindle speeds possible are often essential. The rapidly rotating spindles of the spinning and doubling machines in such service, therefore, require most careful attention, due to their natural tendency to throw oil. It is most important that they be looked after by an experienced mill machinist who understands the principles of lubrication.

The oil level in the spindle bases is particularly important. Inasmuch as they form the oil reservoirs, they should never be more than half full of oil, otherwise it may work upward to drip or be thrown onto the silk yarn of adjacent spindles. This possibility has led many throwsters to prefer the self-oiling type of spindle. Re-oiling of spindles can be most accurately controlled by removing them and carefully filling the reservoirs with oil to the desired level. No oil should be allowed to remain on the outside of the spindle mechanism or to come in contact with the driving tape. This must be guarded against, especially in replacing the spindles, which should be done most carefully to avoid splashing or possible



Courtesy of SKF Industries, Inc.

Fig. 7—Enlarged view of the dampening system on an SKF roller bearing spindle bolster. "a" represents the play between the dampening sleeve and base, and "b" the play between the sleeve and foot of the bolster shell "F".



Courtesy of SKF Industries, Inc.

Fig. 8—The SKF ring brake bolster showing maximum and minimum oil levels. Note the spherical surface "A" which fits into a spherical seat in the base, being held in position under spring pressure by lock "B" and coil spring "C." The latter also presses the dampening sleeve "D" against the brake ring "E."

forcing of the oil onto the whorl or tape. Many authorities feel that better control is made possible by renewing spindle oil in sequence, and not servicing all units at approximately the same time. In silk throwing, the spindle will normally require a comparatively light oil which has been highly refined to render it as nearly stainless as possible. Purity and chemical stability are most important factors; they can be best assured by purchasing such oils from substantial refiners of established integrity.

WORSTED AND WOOLEN

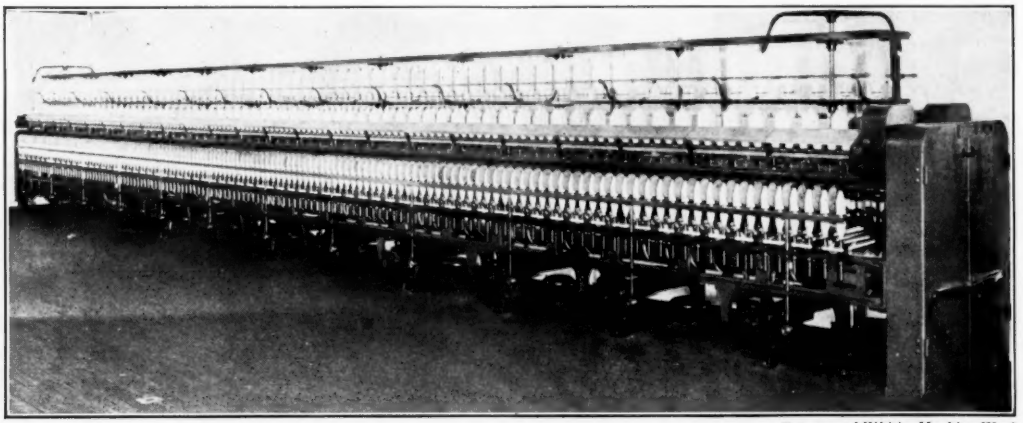
Worsted cap type spindles, are designed to eliminate the oil reservoir, provision being made for mechanical oiling by means of oil-soaked felt located in the rail, which lubricates the tube by wiping action. The oil supply on the felt is renewed twice a day; this must be regularly attended to, otherwise heating and seizing may result if lubrication is not maintained.

Spindle lubrication on the mule frame will differ but little from the ring or cap type frame, with the exception that the bases are open. Under such conditions, the possible development of oil throwing will frequently render it advisable to use a somewhat heavier spindle oil for the oil must, of course, remain in place not only to insure positive lubrication, but also reduce dripping onto the floor and to prevent possible staining of the yarn.

SPINDLE DRIVES

Frictional spindle drives do not require lubrication. In fact, slippage will be bound to occur if they become at all oily. For this reason the frictional drive should always run perfectly dry. Adjacent gearing and exposed silent chain drives which may be installed on some machines should be sparingly lubricated by means of a relatively heavy grade of liquid grease that will not drip. Where ball bearings are installed on the cylinder bearings, the lubricant should be a light bodied grease free from acid and alkali and capable of functioning with minimum torque and power consumption. Roller bearings of the flexible type, however, can generally be best served with a medium to heavy oil.

Belts should also be kept absolutely free of oil and grease; otherwise slippage and deterioration will be bound to occur. If they should become oily, the free oil can usually be absorbed by holding chalk or whitening against the moving belt. The surface should then be carefully scraped with a dull knife to remove all such foreign materials which might interfere with transmission of power.



Courtesy of Whitin Machine Works

Fig. 9—A typical cotton spinning frame adapted to long draft system.

RELATION OF TRAVELER SPEED TO OIL VISCOSITY

Traveler rings must function with the least possible rise in frictional temperature in any type of spinning or twisting operation. Lubrication with a light consistency, comparatively stainless grease is conducive to such operation. These rings are an important part of such equipment and frequently may give rise to trouble due to the excess heat generated by virtue of the work they do. Their lubrication is best accomplished by putting the grease in the palm of the hand and applying it to the rings with a finger, or using a flexible swab. The operator should be careful to avoid excessive lubrication of such rings, due to the possibility of yarn or thread stains when dirt or grit has accumulated on the inner surfaces. This has actuated study of a self-lubricating type of ring employing the principle of wick feed.

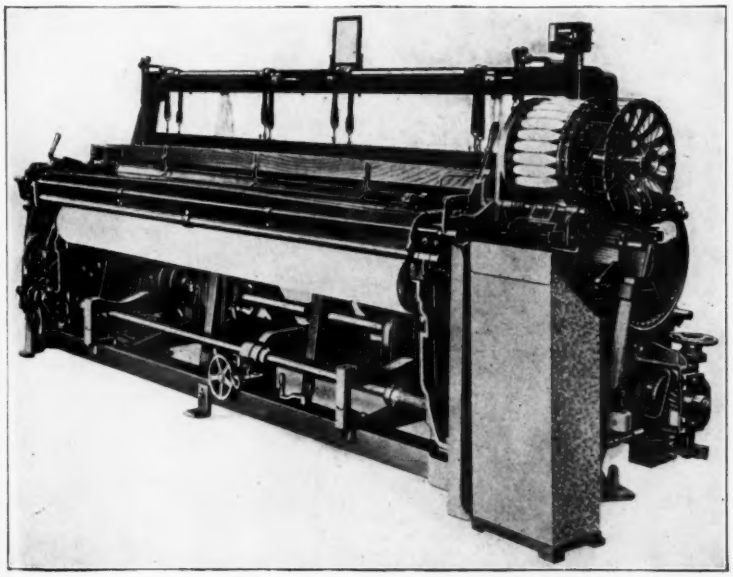
In cotton mill spinning the traveler speed together with the front roll speed are the determining factors for spindle speed and these are dependent upon the character and number of yarn being spun. Traveler speeds ranging from 4500 to 5400 feet per minute are now possible according to the diameter of the ring and the weight of traveler; the larger the ring and the heavier the traveler, the higher the speed possible. These factors, of course, determine the speed of the spindle. For plain bearing spindles, speeds of 10,000 R.P.M. are now considered quite practical for print cloth numbers, some mills running as high as 10,500 in certain instances. To accomplish this successfully, however, careful attention must be given to all details, such as proper-fitting and true-running bobbins, keeping the spindles free from yarn accumulation so as to permit proper seating of the bobbins, and tapes of proper width and flexibility with carefully sewn laps.

RESUME

Spindle design under modern high speed operating conditions has a direct relationship to lubrication. Mention has already been made of the dual function which the spindle oil must perform under such conditions. Just how the oil must behave to assure of best results will be of interest. There was a time when minimum power consumption seemed paramount. Naturally, it was given most serious consideration since it involved such a large percentage of the entire amount of power consumed by the average mill. More recently, however, in the advanced study of spindle design, unit power consumption has become secondary to other factors which have been found to have a greater influence upon continued lubricating efficiency. These factors involve resistance to vaporization, minimum increase in viscosity and low corrosive tendency. All are functions of the chemical stability of the oil, as already mentioned. In other words, just as the modern spindle is designed to operate on an oil within a very definite viscosity range, according to the speed, package and bobbin length, so must this oil, in turn, stay within this viscosity range without sludging or in any other way changing its physical characteristics. Otherwise the basic purposes will be defeated. When a spindle oil stays within the required viscosity range, the tendency towards pumping is also reduced.

Loom Lubrication

The ideal of the far-sighted machine designer is to so apply the accepted principles of mechanics as to enable as perfect coordination of motion as possible. There was a time when this was not entirely practicable; due to the limited nature of the lubricants available adequate prevention of abnormal friction could not be assured. Soon, however, the Petroleum Industry realized it had a part to play in machine preservation and industrial production; then lubricants of a wider variety of characteristics became available, prepared specifically to meet the more intensive operating conditions which were sponsored by increase in speeds and loads, along with reduction in tolerances, as the relation of surface conditions came to be realized.



Courtesy of Draper Corporation

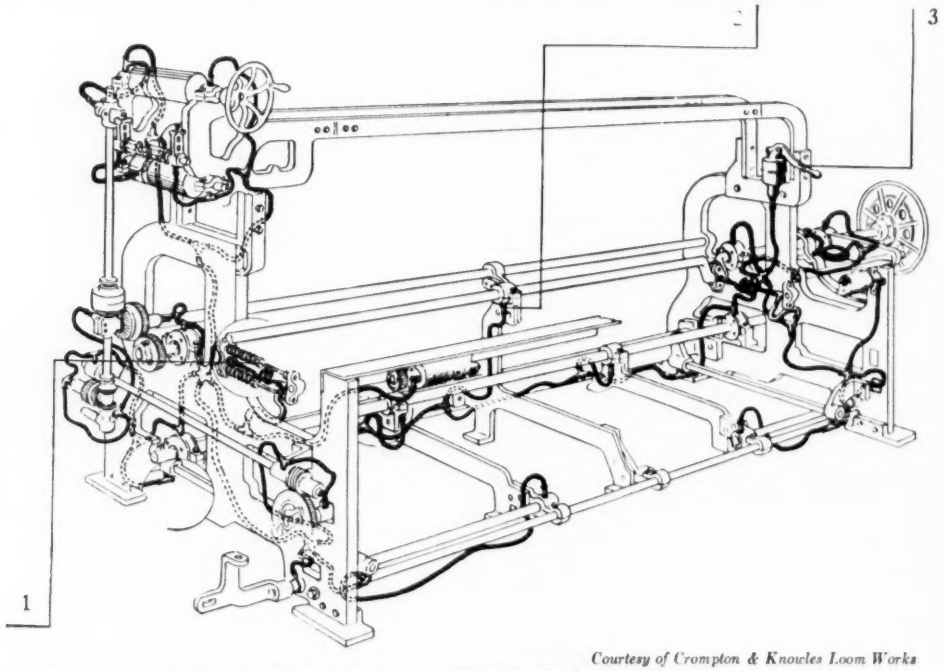
Fig. 10—A Draper Model XL Sheeting Loom. By providing for automatic changing of bobbins speeds can be increased with material reduction in labor.

So we have come to the modern status of industrial production with the paramount emphasis on *speed*. In some industries speed has imposed a severe load upon lubrication, especially where machines are overspeeded to increase their productive output. This has become quite preva-

lent in textile weaving and loom operation.

As compared with some other types of machinery, the loom is not a high speed machine.

The loom is not a difficult machine to lubricate if the limitations of the available lubricants are realized, and then studied with re-

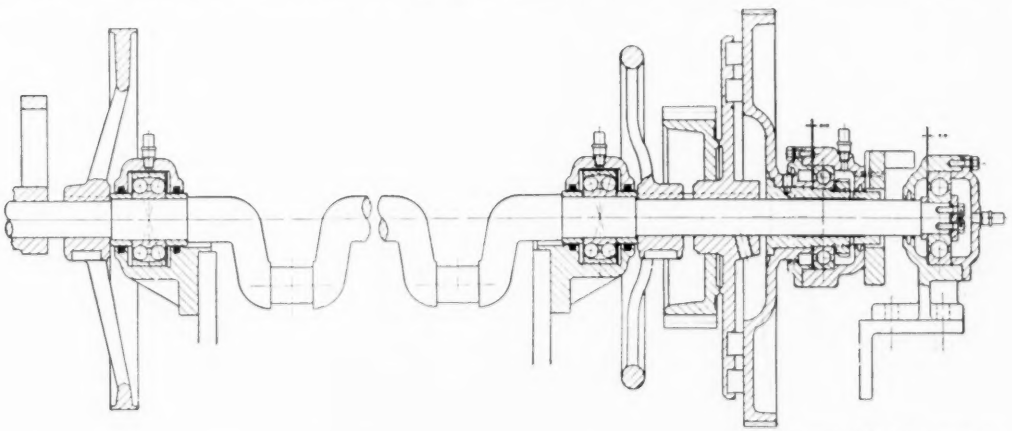


Courtesy of Crompton & Knowles Loom Works

Fig. 11—Line sketch of a loom showing piping elements with location of points of application pertinent to a system of centralized pressure oiling. 1—indicates the crank connector bearings included in the system; 2—is one of the 37 drip plugs; and 3—is the tank and control handle.

The crankshaft rarely turns over more than 225 revolutions per minute, but when it is designed to run at 160 revolutions and is speeded up to 190, the relative increase is comparable to perhaps a thousand revolutions of a spindle, and the load imposed upon lubrication is equally severe.

spect to the design and operating conditions of the parts to be lubricated. Success becomes all the more assured when operators are trained in the art of intelligent application of lubricants. They must learn to realize that they are dealing largely with exposed mechanisms, that too much lubricant may cause "oil spots" on the



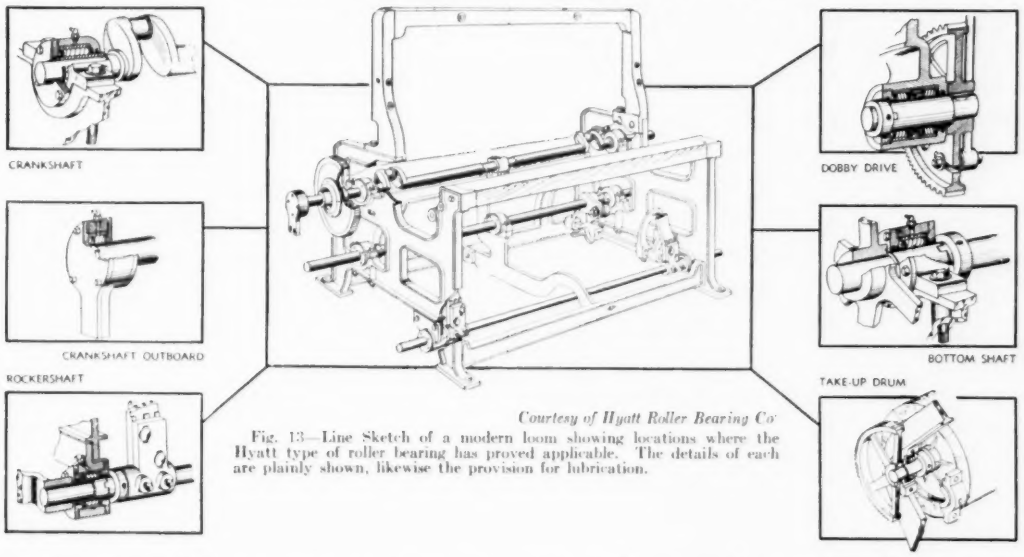
Courtesy of SKF Industries, Inc.

Fig. 12—An assembly of SKF self-aligning ball bearings on the crankshaft of a modern loom, in the interest of saving power, lubricant and maintenance costs.

warp due to throwing, and that less lubricant more frequently and uniformly applied is far better than a lot applied less frequently. This should mean discarding of the grease paddle in favor of a brush, the use of more automatic lubricant fittings, and consideration of the fact

3. Width of the Loom
4. Impact of the Pick, and
5. Method of Lubrication

As these factors may affect lubrication so may they affect the choice of the lubricants employed, especially those intended for head



Courtesy of Hyatt Roller Bearing Co

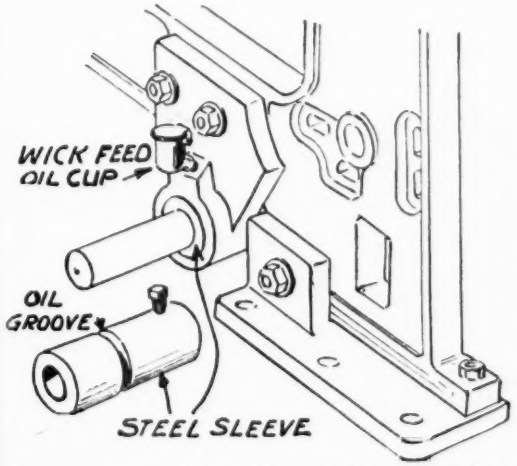
Fig. 13—Line Sketch of a modern loom showing locations where the Hyatt type of roller bearing has proved applicable. The details of each are plainly shown, likewise the provision for lubrication.

that they themselves are quite as important to effective lubrication as the lubricants they may be using.

CONDITIONS WHICH MAY AFFECT LUBRICATION

There are five specific conditions which may affect the lubrication of a loom, viz.:—

1. Speed
2. Type of Cloth



Courtesy of Crompton and Knowles Loom Works

Fig. 14—The rocker shaft bearing of a Crompton and Knowles loom showing one of the steel sleeves which is held by a set-screw to the rocker shaft for the purpose of supporting the weight of the lay in cast iron bearings. This doubles the bearing area, and lends to solution of a difficult lubrication problem by wick-feed oil cups and oil grooves.

gear and cam motions. Most of these will be largely exposed, although guarding of the head gear on the modern motor-driven loom is a decided step in the right direction.

In turn, it is required that any lubricant intended for such service be capable of—

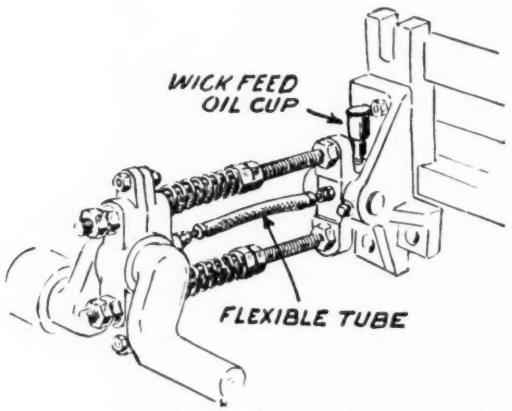
1. Penetrating and developing a suitable adsorbed film.
2. Adhering to gear teeth and cam surfaces to a sufficient degree, to withstand slinging or dripping, and
3. Removal, should oil spots develop.

Surface Finish

Research investigators have developed in their studies of thin film lubrication that as surface finish is improved maintenance of the adsorbed film is more readily accomplished with less lubricant. This film being actually a part of, or adsorbed by the outer molecules of the metallic surfaces in motion with respect to each other, is a veritable reserve against the development of actual metal-to-metal contact. Normally the latter should never occur on any loom part, for loads are never extreme. It might only be possible were they to be allowed to run dry for an extended period of time, beyond the life of the adsorbed film.

So we are quite concerned with surface finish. The loom builder endeavors to render this as perfect as costs will allow. The operator in turn must complete the job by most careful lubrication. It can be done if the lubricant is

carefully chosen and intelligently and regularly applied. The glaze on the tooth surfaces of any properly lubricated head gear, or cam mechanism is ample evidence; as this glaze is developed more perfect rolling of gear teeth is made possible, likewise sliding of cam surfaces



Courtesy of Crompton and Knowles Loom Works

Fig. 15—The Crompton and Knowles shock-absorbing crank connector, and details of the improved oiling system. A wick-feed oil cup at the pin end of each connector feeds oil to both its bearings by means of oil grooves and a flexible tube.

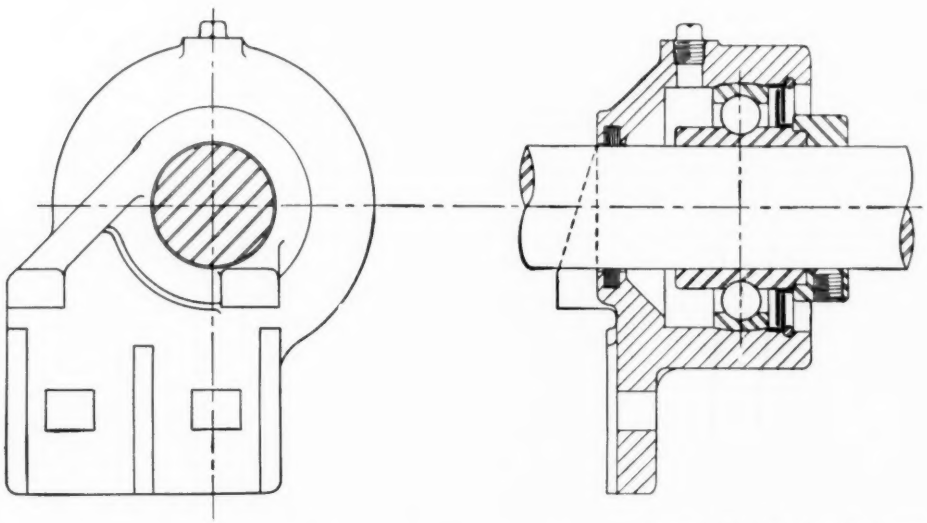
is brought about with minimum friction. Then the only requirement to assure of the occurrence of minimum wear is uniform application of just enough lubricant to thoroughly cover the contact surfaces. An excess is never necessary, and only a detriment as it will probably throw off.

HOW LUBRICATION BECAME IMPORTANT

The modern automatic or precision loom as produced today is the result of the development of an idea which can be traced back to biblical times. It has been a development which originated primarily with the age of mass production, when the machine era of the nineteenth century relieved our grandparents of the necessity of being self-supporting with regard to their bodily needs. Prior to that, weaving had been done at home, or to a limited degree in manufacturing centers such as described in Silas Marner. The principle, involved, however, has changed but little; yarn is still made into cloth by interlacing lengthwise the threads of the warp with those of the weft, by means of a shuttle which passes to and fro across the warp.

The perfection of mechanical means of operating the shuttle, with the adaption of intricate cams for raising and lowering the loom harness motions were the focal points around which the modern high speed automatic loom developed. In turn, these required careful study of crankshaft bearing design along with the bearings of the dobby drive. Inasmuch as positive lubrication was a much desired objective, it was only natural for some builders to turn to the ball and roller bearing as one of the most practicable means of attaining the desired results, with the least possibility of loss of lubricant and oil spots.

In plain weaving each "end" or thread from the loom beam is passed alternately through



Courtesy of The Fafnir Bearing Company

Fig. 16—Camshaft bearing of a Draper Model "E" loom. Note manner of bearing closure. While the sketch shows pipe plugs these bearings are normally fitted by Fafnir with provision for pressure grease lubrication.

the heddles of two harnesses. In fancy weaving, there may be several harnesses employed, the number depending on the design being woven. In operation the harnesses are raised and lowered so that the warp threads give the appearance of a V on its side. Crosswise to the warp and through the "shed" thus formed a "filling" thread is carried by the shuttle and "beat-up" against the woven cloth by a "reed." The harnesses then change position so that some or all threads that were in the upper side of the "shed" are now in the lower and vice-versa; again the shuttle passes through to the opposite box and the laid filling is once more beat-up by the reed. This cycle is repeated for each pick.

During the process the loom beam feeds in the warp in the proper amount and the woven cloth is wound up on a roller. Auxiliary to this operation are attachments for automatically changing bobbins, and for stopping the machine if a thread breaks or shuttle fails to cross the warp completely.

The cam loom is most likely to develop problems of lubrication where under-cam motion is involved and there is possibility of lubricant being thrown from the cam surfaces to the warp to cause subsequent oil spots on the woven ends.

One may also run into difficulty in lubricating the treadle rolls and pick balls especially under over-speed conditions of operation. Good practice dictates grease lubrication of both, by means of a suitable pressure gun. In the former there may be considerable possibility of grease being thrown off especially if fed to excess; in the latter the impact involved may impose a like condition, in addition to tending to change the structure of the metal.

Instructions for Lubrication of C. & W. Type S Looms under Average Conditions of Mill Operation

		Grease System		Oil System			
		Every 3 Mos.	Every Week	Every 3 Mos.	Every Month	Every Week	Twice a Week
Crank shaft bearings	Roller	X			X		
	Plain		X				X
Bottom shaft bearings	Roller	X			X		
	Plain		X				X
Rocker shaft bearings	Roller	X			X		
	Plain		X				X
Dobby drive shaft bearing	Roller	X			X		
	Plain		X				X
Dobby rocker shaft bearings			X			X	
Cone drive shaft bearing	Roller	X			X		
	Plain		X				X
Cone harness shaft bearings			X			X	
Knowles head upright shaft bearings			X				
Knowles head cylinder shaft bearings			X				
Swivel yoke in shipper lever			X				X
Picking shaft bearings			X			X	
Crank connector bearings			X				X
Take-up drum shaft bearings			X			X	
Int take-up gear shaft bearings			X			X	
Motor gear on crank shaft				X			
Waste packed bearing motors				X			
All other open oil holes						X	

Other parts of the loom such as picker rods, shuttle box guides, cam surfaces, gears, etc., should be lubricated often enough to prevent them from operating in a dry condition.

All above based on single shift operation.

Courtesy of Crompton and Knowles Loom Works

Relation of Materials

All of which requires us to realize that the

nature of the iron, steel or alloy which goes to make up many of the wearing parts may have a direct bearing upon lubrication. In the opinion of certain authorities chilled cast iron is probably the most resistant to wear in event of not too thorough lubrication; hence the success which has attended the use of this material for gear and cam mechanisms on certain heavy duty looms. Chilled cast iron is also an excellent bearing material which can be lubricated quite as effectively with a medium bodied quality grease as with a heavy straight mineral oil.

Detriments of Separation:

Any grease for loom service must not separate or lose its oil; if it does, soap accumulations may develop to prevent entry of fresh lubricant, and thereby cause impaired lubrication. Any such tendency to separate may be aggravated if the grease is used in any type of lubricating system involving filters or felt pads. In fact, the latter will very often act as quite effective strainers to entirely remove the soap from low quality greases. Later, since these soap accumulations will clog the filters, insufficient lubricant will reach the moving parts. There is a definite preference, therefore, for straight mineral oils under such conditions, even though the viscosity may have to be raised somewhat to prevent excessive leakage.

Chemical stability is a most important property in any lubricant for loom service, for thereby is resistance to oxidation assured with less possibility for development of non-lubricating gums or discoloring sludge. Chemical stability can only be positively assured of by use of lubricants having maximum resistance to oxidation. This property is also indicative, to some degree, of the tendency which the lubricants will have to discolor. Both should therefore be of interest to the progressive weave-room executive who must have the fineness of his cloth at heart and is thereby most interested in using lubricants which will show the most positive ability to stay where they belong, and if they should throw, will not cause obvious oil spots.

METHODS OF LUBRICATION

The primary thought in the lubrication of weaving machinery is to prevent oil or grease from coming into contact with the yarn or goods at any stage of the process. In fact, oil stains may be so serious where costly fabrics are being manufactured as to lead to a decided tendency among some operators to underlubricate their equipment, thereby taking a chance on excessive wear. This has been fully realized by loom builders in their study of protective means of lubrication.

The result has been a decided trend towards automatic lubrication in the design of modern weaving machinery, oil circulating systems and pressure grease appliances being carefully considered. On such machines manual control is still essential, but at less frequent intervals than where hand application is necessary. In many plants each machine operator is responsible for the lubrication, operation and production of his own machine. Others consider it best practice to have lubrication taken care of by the loom fixers in charge of the section, in the interest of centralizing responsibility and improving machine economy. Uniformity in application of lubricants is most important; to this end assignment of one or more qualified mechanics to take care of all plant lubrication is being looked upon very favorably.

The nature and construction of the wearing elements involved will, of course, have an influence upon the frequency of lubrication and the manner in which this can best be accomplished. For smaller bearings, a high grade machine oil of approximately 250 to 500 seconds Saybolt viscosity at 100 degrees Fahr., will be suitable. For the lubrication of larger bearings, such as rolls, the use of a somewhat heavier lubricant may be advisable. Frequently a good grade of light grease will give best results, and the trend is to provide lubricating devices to handle such a product.

Gears and chains, in turn, will require considerable care in their lubrication, to prevent dripping or throwing of the lubricant on to the warp or woven goods. For this reason a fairly adhesive grease will generally give best results, although it is perfectly practicable to use a relatively heavy oil if it is sparingly applied. Both gears and driving chains of the so-called silent type, if located in relatively oil-tight casings, will probably function best if lubricated with a straight mineral oil of approximately 100 to 150 seconds Saybolt viscosity at 210 degrees Fahr.

Printed in U. S. A. by
EDGAR C. RUWE CO., INC.,
72 Washington St., N. Y. C.